OSA -1636-66
cy 1 of 2

31 March 1966

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#2 JP+Rop

25X1A To: [redacted]

Subject: SUIT AND HELMET SESSION WITH [redacted] OF DAVID CLARK, 23 MARCH 1966 25X1A

25X1A

25X1A It was agreed between [redacted] of David Clark and [redacted]
25X1A and [redacted] ADP that helmet thermal improvements are desireable as follows:

Helmet Shell:

OK Phase I — Immediate. Aluminize the exterior in place of the present white paint, to provide a reflective rather than absorptive surface.

Long term effort - not called for at this time. Phase II — Development - After evaluating results of other improvements. Insulate or revise the shell to reduce its thermal conductivity. This may require double wall construction to reduce or eliminate weight increase. ?

Visor - Pressure Faceplace:

1. Shall not be provided with I.R. coating. Such a coating would be the most desireable approach thermally, giving us full time attenuation of heat build-up in the material as opposed to the part time auxiliary sun shield usage defined below. However, at the present state-of-the art, its mirror effect would severely reduce visibility, already a problem. OK

2. Shall be coated at both surfaces with anti-glare coating. Electric face heat was not discussed in this session. Being done — being done

3. Applying the anti-glare coating to the existing plastic faceplate is known to be difficult, but efforts to have this accomplished shall be continued. Negative — need more info.

[illegible]

PPG — mounting not presently compatible with larger shields etc. — DC to make adapter

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Five PPG visors exist - dbl layer inside & outside. Three layer coating coming next april (OCL) One from PPG

4. The first anti-glare faceplates will therefore be the laminated glass version made by Pittsburgh Plate Glass Company. At least three of the glass versions exist at the moment and [redacted] states that these are already coated on at least one side with a triple layer of magnesium fluoride. get up to date 25X1A

5. David Clark has four faceplates at Santa Rosa, California at the moment for coating. [redacted] was not aware as to whether these are plastic or glass or some of each. which 25X1A

All PPG

Sun Shields - Infra-Red Reflective:

Right

1. It was concluded that a single panel I. R. shield with a clear lower section and an upper sunshade section would be unsatisfactory and should not be considered further; the most apparent of several problems is that when flying into the sun, the illuminated lower face would cause very bad self-reflection in the sunshade portion.

Mountings on Gemini & Apollo helmets not relative. No loan.

2. The hardware problems of mounting and operating multiple auxiliary shields have already been solved on the Gemini helmet, so we felt no compunction about specifying the double shields below. However, having no feel for what we will be getting into, we would like to have a sample to examine [redacted] will transmit to [redacted] our request to arrange if possible for a two week loan of a typical two sunshield helmet. compatibility with helmet picture 25X1A 25X1A

3. Two separate sunshield configurations should be made for test, each with I. R. reflective coating on the outer surface and anti-glare coating on the inner surface.

4 being procured - I R outside A R inside

A. Clear Sunshade - This will be of a material and thickness similar to the existing dark green sunshade, except clear.

B. Sunshade - This will be like our existing dark green sunshade, except for the coatings as stated. The I. R. coating may turn out to be a gold deposition, but no where near the density of the Gemini gold shield we have been testing. ?

No — our effort here

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4. Without being familiar with the mechanics of the Gemini hardware, we stated more or less conversationally that the clear shield should be the one to come down with the first manipulation of the knob, and that it would be satisfactory, and possibly desireable, to have both shields down if the sunshade were needed. These ideas may or may not be significant in terms of the actual hardware.

negative

problems

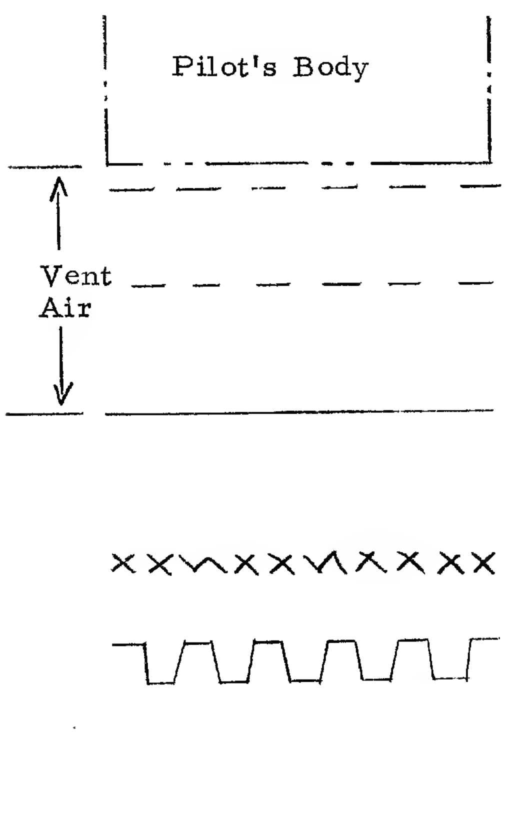
Suit Outer Surface Decision:

It is becoming obvious that the suit must reflect both solar and I. R. wavelengths in the cockpit environment vs. the solar only problem for Gemini. This means that the new ? aluminized suit will be better as shown in our SP-795 report which you have. The final decision as to the use of aluminized or white HT will be the result of flight usage and comparing well worn and washed garments.

Other Suit Considerations:

In further discussions with [redacted]e stated that he considers the following composite to be what we will have in the first partially insulated suits, and left us a sample of each layer: 25X1A

True



(1) P7084 Underwear (cotton).

(2) P729 Comfort Liner (Sage green Oxford nylon).

(3) P1807A Gas Container (Neoprene impregnated nylon; neoprene surface toward body).

(4) P5018 Restraint (HT Link Net).

(5) "Super-Spacer", no number assigned. (Dimple-formed nylon tricot, aluminized on outer surface). Selected zones only.

(6) ACS 1440 C Coverall (Nylon, aluminized on outer surface).

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Other samples left with us for interest are:

A. Mercerized Cotton - No number assigned as yet (sample is dark blue). Being considered as replacement for the nylon comfort liner (layer #2 above) due to better air permeability and insulation characteristics. David Clark does not yet stock any of this material. ?

B. "Super-Spacer" sample aluminized by applying a layer of aluminized mylar on a trial basis. For various reasons, including stiffness, this is not being considered for real use at the moment. Sample is very shiny, giving the appearance of being covered with fresh aluminum foil.

C. Regarding the sample of "Super-Spacer" left with us as representing layer #5 in the trial suit composite defined above. This sample, aluminized by vacuum deposition, is very dull in appearance, especially when compared with the shiny sample just described. This was made early in the learning stage, however, and they expect considerable improvement in the actual material used.

D. "Super-Spacer" sample (pink) before being aluminized. This and the aluminized samples are all approximately six inch squares from the same tooling, stitched together as required. ?

E. Sample of present aluminized outer surface material ACS 1440C coated with an abrasion resistant film. No number has been assigned to this combination, but [redacted] states they are considering it as a possible next step in outer surface improvement. To the eye and by his test measurements it is considerably less reflective than new bare ACS 1440C; however, a comparison after accelerated wear tests shows the coated version to be nearly as good as when new, versus serious degradation of the present bare material. We are not in full agreement as yet, however, that the coated material should be the "next step" in improvement of the surface. We do not have a copy of their report, but from a cursory glance at his reflectance curves during our session it appeared that the present material's reflectance when new is so superior that we should not too hurriedly discard it merely for the sake of better wear. ?

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Although the present bare material is still fairly new to the program, it is already known to far exceed the previous surface in wear qualities. We should wait

new?

what?

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for more experience in the time taken for it to degrade to the level of the less reflective coated material; if this time were fairly short, say a few weeks, it would obviously be better to start out with the coated material in the first place. It is our impression from [redacted] however, that the bare ACS 1440C may be good for a number of months. 25X1A

F. Sample of ACS 2246, the white cover-all material before being aluminized.

G. Sample, un-numbered, of one experimental outer surface aluminized by applying 1/4 mil mylar which has been aluminized on each side. Excessively stiff for suit usage.

H. Sample of white P5995, Gemini's outer cover-all material. ?

I. Sample of P7251, white Dacron, from which for some reason an entire test cover-all was made and tried in the Firewel chamber. Performance was said to be very poor.

Time did not permit more than a glance at most of David Clark's preliminary report, of which they will send us a copy when complete. They have done a considerable amount of valuable test work in determining the physical and thermal characteristics of a number of possible suit materials and suit composites.

One large area of disagreement became apparent, however, when we noticed that their thermal conductivity values for the various hard cloths, etc., were several times better than ordinary insulation materials. The reason for this seeming paradox turned out to be that their tests were made in an evacuated bell jar at a very low pressure. It is known that by far the major portion of heat transfer through fibrous insulations at sea level is contributed by air conduction, and researchers have found that reduction of pressure gives only negligible improvement in insulation value until about 1/10 of an atmosphere is reached, let alone the 1/3 atmosphere of our cockpit.

Thus, we must consider that the absolute k values from their bell jar tests True? are not directly applicable for suit calculation purposes at our conditions. This does not, however, detract from the fact that their findings are extremely valuable from the standpoint of comparison if, for example, the degree of improvement in the thermal performance of a given composite can be predicted for a change in one or more of the layers. [redacted] assures us that he feels the information can indeed be so used, and in fact can be seen to work this way when the test results of various composites are compared. 25X1A

31 March 1966

As regards pressure reduction's effect on k value, we have since forwarded to [redacted] a reproduction of the following ASME Heat Transfer Division paper: 25X1A

"HEAT TRANSFER BY GAS CONDUCTION AND RADIATION IN FIBROUS INSULATIONS", by Verschoor and Greebler, physicists at Johns-Manville Research Center

This is a very definitive and practical reference paper on the matter, and although it deals specifically with fiberglass insulations, the effects should be parallel for any porous or semi-porous material, and especially fabrics.

25X1A

Best regards,

[redacted]

meb

cc: J. Parangosky
[redacted] 25X1A

4-4-66 [redacted] 25X1A

(1 of 2 cys)

25X1A

To: [redacted]

From:

March 29, 1966

Subject: RECORD OF SUIT AND HELMET SESSION WITH [redacted] OF DAVID CLARK, MARCH 23, 1966

25X1A

HELMET DECISIONS:

It was agreed between Walter, [redacted] and myself that thermal improvements shall be made as follows: 25X1A

HELMET SHELL:

Stage (1). (Immediate). Aluminize the exterior in place of the present white paint, to provide a reflective rather than absorptive surface.

Stage (2). Insulate or revise the shell to reduce its thermal conductivity. This may require double wall construction to reduce or eliminate weight increase.

VISOR (PRESSURE FACEPLATE):

(1). Shall not be provided with I.R. coating. Such a coating would be the most desirable approach thermally, giving us full time attenuation of heat build-up in the material as opposed to the part time auxiliary shield usage defined below. However, at the present state-of-the-art, its mirror effect would severely reduce visibility, already a problem.

(2). Shall be coated at both surfaces with anti-glare coating. (Electric face heat was not discussed in this session and I am not personally familiar with this aspect of the matter.)

(3). Applying the anti-glare coating to the existing plastic faceplate is known to be difficult, but efforts to have this accomplished shall be continued.

(4). The first anti-glare faceplates will therefore be the laminated glass version made by Pittsburgh Plate Glass Company. It appears that at least three of the glass versions exist at the moment, and Walter states that these are already coated on at least one side with a triple layer of magnesium fluoride.

(5). David Clark has four faceplates at Santa Rosa at the moment for coating. Walter was not aware as to whether these are plastic or glass or some of each.

AUXILIARY FACE SHIELDS (Infra-Red Reflective):

(1). It was concluded that a single panel I.R. shield with a clear lower section and an upper sunshade section would be unsatisfactory and should not be considered further; the most apparent of several problems is that when flying into the sun, the illuminated face would cause very bad self-reflection in the sunshade portion.

(2). The hardware problems of mounting and operating multiple auxiliary shields have already been solved on the Gemini helmet, so we felt no compunction about specifying the double shields below. However, having no feel for what we will be getting, we would like to have a sample to examine; Walter will transmit to [redacted] our request to arrange if possible for a two-week loan of a typical helmet. 25X1A

(3). Two separate auxiliary shields shall be provided, each with I.R. reflective coating on the outer surface and anti-glare coating on the inner surface.

CLEAR SHIELD - This will be of a material and thickness similar to the existing dark green sunshade, except clear.

SUNSHADE - This will be like our existing dark green sunshade except for the coatings as stated. The I.R. coating may turn out to be a gold deposition, but nowhere near the density of the Gemini gold shield we have been testing.

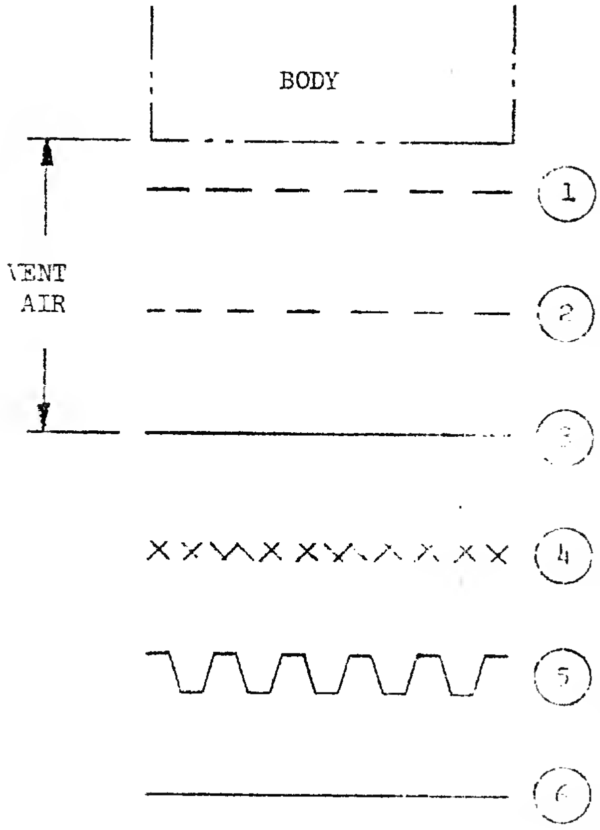
(4). Without being familiar with the mechanics of the hardware, we stated more or less conversationally that the clear shield should be the one to come down with the first manipulation of the knob, and that it would be satisfactory (and possibly desirable) to have both shields down if the sunshade were needed. These stipulations may or may not be significant in terms of the actual hardware.

SUIT OUTER SURFACE DECISION:

It was agreed between [redacted] and myself that the outer surface of the suit should remain aluminized, and that no further consideration should be given to changing to a white surface. This is consistent with the "real" cockpit environment, wherein the suit surface must efficiently reflect not just solar but both solar and I.R. wavelengths, as pointed out in my Suit Problem Report SP 795. 25X1A

OTHER SUIT CONSIDERATIONS:

In further discussions between Walter and myself he stated that he considers the following composite to be what we will have in the first partially insulated suits, and left us a sample of each layer:



1. P7084 Underwear (Cotton).
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"Super-Spacer" sample aluminized by applying a layer of aluminized mylar on a trial basis. For various reasons, including stiffness, this is not being considered for real use at the moment. Sample is very shiny, giving the appearance of being covered with fresh aluminum foil.

(As regards the sample of "Super-Spacer" left with us as representing layer #5 in the trial suit composite defined above: This sample, aluminized by vacuum deposition, is very dull in appearance, especially when compared with the shiny sample just described. This was made early in the learning stage, however, and Walter expects considerable improvement in the actual material used.)

"Super-Spacer" sample (pink) before being aluminized. This and the aluminized samples are all approximately 6" squares, the size of Walter's development tooling. For the first flight-trial suits the "Super-Spacer" layer, where used, will probably consist of 6" squares from the same tooling, stitched together as required.

Sample of present aluminized outer surface material ACS 1440C coated with an abrasion resistant film. No number has been assigned to this combination, but Walter states they are considering it as a possible next step in outer surface improvement. To the eye and by his test measurements it is considerably <u>less</u> reflective than new bare ACS 1440C; however, a comparison after accelerated wear tests shows the coated version to be nearly as good as when new, versus serious degradation of the present bare material. I am not in full agreement as yet, however, that the coated material should be the "next step" in improvement of the surface. We do not have a copy of Walter's report, but from a cursory glance at his reflectance curves during our session it appeared that the present material's reflectance when new is so superior that we should not too hurriedly discard it merely for the sake of better wear. Although the present bare material is still fairly new to the program, it is already known to far exceed the previous surface in wear qualities. We should wait for more experience in the time taken for it to degrade to the level of the less reflective coated material; if this time were fairly short, say a few weeks, it would obviously be better to start out with the coated material in the first place, from a monetary standpoint if nothing else. It is my impression from Walter, however, that the bare ACS 1440C may be good for a number of months.

Sample of ACS 2246, the white coverall material before being aluminized.

Sample (un-numbered) of one experimental outer surface aluminized by applying $\frac{1}{4}$ mil mylar which has been aluminized on each side. Excessively stiff for suit usage.

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[redacted] 25X1A

DBC:pac

25X1A cc: [redacted]